HEAT PUMP AND SOLAR ENERGY SYSTEMS AND THEIR COMBINATION FOR HEATING

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ABSTRACT

This paper deals with modern heating sources which we can assign to unconventional sources of energy. Especially describing heat pumps and solar energy systems and their combination for using in establishment.

1. INTRODUCTION

The heat sources in our establishments doesn't need to be only coal, gas or electric energy, but in the present time are in the target of our interests "unconventional sources of energy". In this group are many sources for example – wood, biomass, wind, solar radiation and more and exploitation of each other of these sources has theirs protagonists and contenstants. One form how to change "natural heat" to heat for heating and water heating is exploitation of heat pumps.

According to from which heat source they exploiting most frequently we talking about heat pumps of air/water or ground/water. In first case is cooling medium (source of energy) air, from whom we acquiring energy for heating hot water or heat household water. In second case is low potentional heat acqurinig from ground by the help of collectors, plastic tubes, where cycling antifreezing mixture. They are located in surface layer of soil in depth from 1 to 1,2 metres, or in boreholes. Depth of boreholes may be about tens of metres and depending on tackles of heat for given object. Flat collectors in surface of soil layer are fewer financially

Fig.1. Heat pump (Fighter 2010 air/water)

Fig.2. Heat pump (Fighter1210 ground/water)

demanding but they needs rather big space. Althought the collectors in boreholes are rather expensive solution but they have a stable tempereatures without special demands on largeness of space.

Heat pumps are speciality which assuring ventilation and exploiting heat which is comprehend in draffish air which would be launched out wihout service. Forced ventilation is become in good insulated houses with tighted windows for example in Sweden is common to exploit for ventilation exactly heat pumps which salvaging energy of launched air.

There are existing a special equipments, which are complements of heat pumps ground/water. They ensuring ventilation and heat which is acquiring from draffish air exploit for increasing of efficiency of heat pump for rapidly regeneration of graounded collectors.

Energy ratio which we acquire from heat pump and energy which we must deliver is called fusing factor and is necessary characteristic of each pump. Magnitude of fusing factor depending not only on heat pump but on conditions by whose are defining difference bewtween tempereature on input of heat pump and temperature on output to fusing circuit. The heat pump is working effectively when this difference is smaller. Usually the fusing factor is within the limts from 3 to 4 which means that about 65 – 75% of energy necessary for heating and preparation TUV acquiring from nature cost free.

From written above is liquet that using of heat pumps is very favourable for low-temperature fusing systems especially for wall and floor warming. Of course is possible to exploit a radiators. Necessary by the projecting of desirable heat pump is to know that like this fusing system is much sensitive on right proportioning and constructing of full system and it is advisable this regard as early as project is in preparation.

From aspect of charges and operation are unproposing heat pump so that covers 100% of heat losses of house but from the rule just maximum 70% of computed value. The rest of demand is then covered by the other so-called bivalent source . Advantge is electrical fusing entity which is servient as a electro-cauldron. This solution is favourable hence that till is in house installed heat pump is possible to acquire from deliver of electricity special small tarif rate for the duration of 22 hours per day. In summer is possible to exploit heat pumps also for cooling – climatization of objects in connection with special units and fan coils.

By the choice of heat pump is allways necessary to appreciate each object individually basically on theirs heat losses and demanding on bulk of heat water eventually calculating with pool heating. According to conditions in given place then is necessary to choose if we use cheaper flat collector or colector which is located in borehole or if we prefered air pump.

By increasing of costs of energy and increased accent on exploiting of renewable resources increasing sense of finding new possibilities of melting and heating of hot household water. For example in Sweden are in present day istalled about 300 000 heat pumps and in other highly-developed countries rapidly increasing theirs quantity. The heat pumps ar example of modern, economical and ecological heating.

2. HEAT PUMPS AND SOLAR SYSTEMS FOR SUPPLY WATER HEATING

Combination of heat pump and solar system is very popular at the architects and on the other hand also at the community. Most frequently are solar systems which are exploiting for heating of water. Imagine of heat acquired for cost free from Sun is very attractive. Neverthless is also based on right consideration?

In text below is described solar system for heating of household water for familiar house with four person.

2.1 INVESTMENTS TO SOLAR SYSTEM

Our naturalistic and geographic conditions are not for exploitation of sun energy so much favourable that would be possible to predict that amateur products will be better in delivery of establishment with hot water for

each time of the year. Thus is most suitable to rely up on professional manufactured and installed system. Although this case is not cheaper.

2.2 OPERATION COSTS OF SOLAR SYSTEM

Although it appears be self system operation without any other outlays but in fact it isn't like that. Every three years it is advisable to verify system every six years is necessary to change cooling medium. Except this it is advisable take due note of that lifetime of some components is shorter than lifetim of system as a bulk. Lower costs also represents requirement of energy for circle pump. In case that exploiting of high quality parts is not necessary to consider reinvestments to solar reservoir and it is possible to simplify only necessary maintanance and requirement of energy. The level of operating costs in calculation to one year of operation are in figure 3.

Operating costs per one year	(CZK/one year)
Consumption costs of electric energy with circle pump and control unit	72 CZK
Exchange costs on old colling medium	177 CZK
Service costs	1000 CZK
Relative cost on exchange of circle pump	250 CZK
Average operation costs per year	1499 CZK

Fig. 3 Average costs per one year for operation of solar system

2.3 HEAT PRODUCTION AND PRICES OF SOLAR SYSTEM

Given system has sheet of collectors in summary about 5,2 m^2 . Basically on quantity of incident radiation and properties of system is possible with relative precision to predict quantity of produced heat during the year. Assumption is optimalization of collectors orientation on south to the southwest with 45^o angle.

Predicted lifetime of solar system is 20 years.

Overall energy in 20 years	65 720 kWh
Overall costs in 20 years	156 308 CZK
Costs of produced energy	2,38 CZK/kWh

Fig. 4 Energy costs produced with solar system

Price of energy produced with solar system is higher than price of energy produced with heat pump. Thus is investment to solar system evidently unefective and irreclaimable. Exploiting of next sorce of energy except of source ehich decreasing exploiting per year of heat pump.

Solar system connection to system is from economical aspect is less suitable because solar system for heating is more expensive than when is using only for heating of supply water. Exception can be exploiting of solar system any atypical approach for example if solar collectors are exploiting as a source of lowpotencional heat for heat pump. This cases cannot be generalized but it is necessary to appreciate individualy with high providence.

3. PROPOSITION PRINCIPLES OF SOLAR POWER SYSTEMS

With proposition of solar power systems we issuing from prpose of conceptional technical solution and funkcional connection individual circuit and individual equipments. Concerning on missing legislative instructions and technical norms in field of proposing and operating od solar power systems, we concerning from projecting experiences of already relized equipments as well as from acquired operating states in Slovak climatic conditions and background papers from abroad. Basically on teoretical analyze of solar power systems is possible by theirs proposing and projecting we issuing from following recommendations and criterions according to exploting aproaches and operting time.

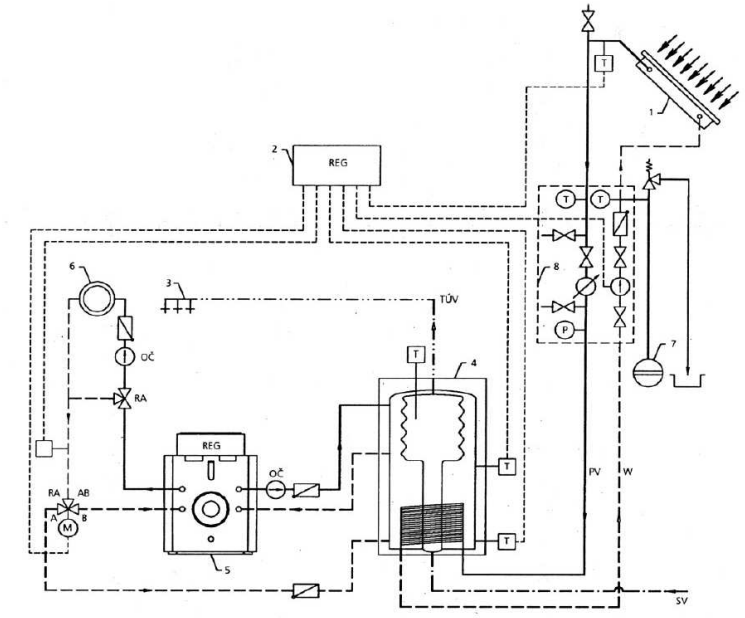

Fig. 5 Pattern of solar bivalent system for heating without acumulation of thermal energy

3.1 SYSTEMS FOR HEATING OF HOT SUPPLY WATER

Seasonal heating: operation time april (may) till to september desired temperature of water from 40 to 45 ^{o}C minimal sheet of collectors from 6 to 8 m^2 per one flat or family house in assumption than 1 m^2 of collectors field heat 40 to 60 l of water per day, solar collectors with teoretical efficiency min. 55% with one cover glass, angle is 30^{o} to 45^{o}, capacity of water reservoir is 200 to 300 litres, for 1 or 2 dayly acumulation of heat capacity of heat resevoir min. 500 litres cooling medium is water one-circuit monovalent system with additional electrical heating field 90 to 100 % of heat consumption cover by solar energy, measurement and regulation with regulator of heat difference, heat sensing device on output from collectors and input to reservoir.

Yearalong heating: operation time from march till to october or during all year, desired tempereature of water min. 45 ^{o}C, min. field of colletors from 6 to 12 m2 on one flat or family house according to heat consumption pitch angle of collectors is from 40 to 60^{o}, heating efficiency of collectors min. 60%, reservoir capacity of heat water from 300 to 500 litres reservoir of heat on 1 or 2 day capacity acumulation from 500 to 1000 litres for additional water heating capacity of reservoir 100 to 200 litres on 1 flat, cooling madiums are antifreezing liquids, bivalent system two or three circuit 60 to 70% -ly consumption cover of heat by solar energy, automatic regulation with regulator of heat difference with heat sensors and with regulation armatures.

3.2 SYSTEMS FOR OBJECTS HEATING

Desired temperature of water min. 30 ^{o}Ccollectors field 15 to 25 m^2 on flat, 20 to 25 m^2 for family house pitch angle 40 to 65 ^{o}C, heat reservoir capacity 1000 to 2500 litres, cooling medium antifreezing and syntetical

liquids, additional source sized on maximal heat demand for heating bivalent two or three-circuit or trivalent multiple-circuit system, from 20 to 30% of consumption cover of heat with solar energy, automatic regulation in solar circuit and in circuit of additional source.

Heating: desired temperature of water min. 30 ^{o}C, field of collectors from 15 to 25 m^{2} on one flat, pitch angle is 45 to 60^{o}, reservoir of heating water with one day acumulation 1500 to 2000 l, long-time reservoir of heat min. 5m^{3} on one flat charging time 5 to 7 months, temperature by charging proces from 30 to 70 ^{o}C, specific thermal loss of building q<0,5 W.m^{-3}.K^{-1}, bivalent and trivalent systems, maximal heat consuption on object heating 80 W.m^{-2}, low-temperature heating system automatic regulation in each circuit of heat source.

4. CONCLUSIONS

Heat pump is in comparison with other heat sources has cheaper possibilities of heat production in operation. First place in operation costs has for very low costs on heat production and also for cheaper costs for cover of electric energy demands, which is connected with bargain tarif rate for power purchase in customers with heat pump. In assumption, that this tax allowance would not exist, it would be from aspect of operating costs of heat pump able to compete only uncomfortableness heating with solid propellants. Against increasing costs of energy is investment to heat pump little sensitive.

From economical aspect investment valuation is heat pump very expedience for non business subjects. Because of recent tax instructions has businessman and company privileges, whose savings of operating costs increasing tax from receipts.

Combination of heat pump with solar system for preparation TUV is economicaly ineffective. Energy produced with heat pump is so much cheaper, that cannot look forward to economic return to solar system.

5. REFERENCES

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